


REMARKS

The amendment is submitted to insert reference to the PCT application and to remove multiple dependency from the claims.

Respectfully submitted,  
BIERMAN, MUSERLIAN AND LUCAS

  
Charles A. Muserlian, #19,683  
Attorney for Applicant(s)  
Tel. # (212) 661-8000

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Enclosures: Marked-Up Version of Specification and Claims  
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Vacuum holding device

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This application is a 371 of PCT/DE00/02362 filed July 18, 2000.  
The invention relates to a vacuum holding device with a vacuum chamber and valve for permanent holding to surfaces substantially impermeable to gas.

Vacuum holding devices such as suction-cup fastenings are inherently known. Conventional suction-cup fastenings have a suction cup which is made of an elastic plastic material and should ensure an airtight seal between the suction cone and a smooth, gas-impermeable contact surface, e.g. a bathroom tile. The vacuum required for the adhesive action in the suction chamber is produced by pressing the plate-shaped suction surface onto the contact surface whereby air escapes from the suction chamber and a vacuum is produced by means of the restoring force of the elastic material. If necessary, surface adhesion forces are also involved in the adhesive action.

Also known are suction-cup fastenings which allow easy removal of the suction-cup fastening from the contact surface, where by means of a seal to be opened, the vacuum in the suction chamber is raised by equalising with the ambient pressure. For this purpose US 5,511,752 proposes a cap mounted displaceably on a suction cup wherein the sliding or lifting of the cap brings about the opening of the suction chamber to the outside and an inflow of ambient air. The vacuum responsible for the suction action is removed, which releases the suction cap.

US 5,553,837 also discloses a vacuum holding device for workpieces which has vacuum chambers and airtight-closing seals to the bearing surfaces in order to hold workpieces tightly on surfaces by application of vacuum by means of a connection to a vacuum pump or to release them again by re-establishing normal pressure.

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MARKED-UP VERSION OF CLAIMS

PCT/DE00/02362

A-99 015 PCT

CLAIMS

1. A vacuum holding device (1) with apparatus for producing a vacuum, wherein

- the vacuum holding device (1) and the apparatus for producing a vacuum are constructed in two parts and can be detached and connected substantially gastight by positioning,

wherein the vacuum holding device has:

- a vacuum chamber (5) which is open in the direction of a contact surface (14),
- an opening as the end of a connection from the vacuum chamber to the external environment (7),
- a valve (9) which ensures gastight closing and opening of the connection between the vacuum chamber (5) and the external environment (7),
- means for producing a detachable substantially gastight coupling between the outwardly directed opening and a device to produce a vacuum.

characterised in that

- the vacuum holding device (1) has a seal (15) which seals the vacuum chamber gastight against the contact surface (14) towards the outside,

and the apparatus for producing a vacuum has

- a piston suction pipe (13) which has openings at the beginning (24) and at the end of the suction path (26).

- 2 -

2. The vacuum holding device (1) according to Claim 1, characterised in that the valve (9) is constructed as substantially conical, spherical or hemispherical.
3. The vacuum holding device (1) according to <sup>claim 1</sup> ~~one of the~~ <sup>wherein</sup> ~~preceding claims~~, characterised in that the connection between the vacuum chamber (5) and the external environment has a conical, spherical or hemispherical bearing surface (8) to accommodate the valve (9).
4. The vacuum holding device (1) according to <sup>claim 1, wherein</sup> ~~one of the~~ ~~preceding claims~~, characterised in that, at least in the regions in contact with the bearing surface (8), the valve (9) consists of a rubber elastic material.
5. The vacuum holding device (1) according to <sup>claim 1</sup> ~~one of the~~ <sup>wherein</sup> ~~preceding claims~~, characterised in that one part of the means for producing a detachable, substantially gastight coupling from the upwardly directed opening is a surface.
6. The vacuum holding device (1) according to <sup>claim 1</sup> ~~one of the~~ <sup>wherein</sup> ~~preceding claims~~, characterised in that the detachable, substantially gastight coupling is formed by a rubber seal between the surface and attachment of the device to produce a vacuum.
7. The vacuum holding device (1) according to <sup>claim 1</sup> ~~one of the~~ <sup>wherein</sup> ~~preceding claims~~, characterised in that the surface (12) for attaching the device to produce a vacuum is directed parallel to the contact surface (14) of the vacuum holding device (1).
8. The vacuum holding device (1) according to <sup>claim 1</sup> ~~one of the~~ <sup>wherein</sup> ~~preceding claims~~, characterised in that the vacuum holding device (1) has a holding receptacle for the equipment holder.

- 3 -

9. A method for securing <sup>a</sup>the vacuum holding device (1) by means of an apparatus for producing a vacuum according to ~~one of the preceding claims~~ <sup>claim 1</sup> to a contact surface (14), ~~characterised by the following steps:~~ <sup>comprising</sup>

- positioning the vacuum holding device (1) on a contact surface (14),
- producing a detachable, substantially gastight coupling between the outwardly directed opening of the vacuum holding device (1) and the piston suction pipe (13),
- producing a vacuum in the vacuum chamber (5) by withdrawing the suction piston (28) from the piston suction pipe (13) until the suction piston (28) passes an upper opening (26) and
- removing the apparatus for producing a vacuum.

10. A vacuum holding device (1), wherein the vacuum holding device has:

- a vacuum chamber (5) which is open in the direction of the contact surface (14),
- an opening at the end of a connection between the vacuum chamber and the external environment (7),
- a valve (9) which ensures gastight closing and opening of the connection between the vacuum chamber (5) and the external environment (7) and
- means for producing a detachable substantially gastight coupling between the outwardly directed opening and an apparatus for producing a vacuum,
- the valve (9) is constructed as substantially conical, spherical or hemispherical and
- the connection between the vacuum chamber (5) and the external environment has a conical, spherical or hemispherical bearing surface (8) to accommodate the valve (9),

- 4 -

characterised in that

the vacuum holding device has a seal (15) which closes the vacuum chamber gastight towards the outside against the contact surface (14) and  
- the valve (9) extends downwards as a strip or rod.

11. The vacuum holding device (1) according to Claim 10, characterised that at the end of the strip or rod there is at least one support, preferably in the form of at least one pin or wedge.
12. The vacuum holding device (1) according to Claim 10 ~~or 11~~ <sup>wherein</sup> characterised in that the strip or rod-shaped extension of the valve (9) is elastic in order to hold the valve in the bearing surface.
13. The vacuum holding device (1) according to ~~one of~~ Claims 10 ~~to 12~~ <sup>wherein</sup> characterised in that the seal (15) is a flat seal made of elastic material.
14. The vacuum holding device (1) according to ~~one of~~ Claims 1 ~~to 8~~ <sup>wherein</sup> characterised in that the seal (15) is a flat seal made of an elastic material.

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